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1958-1983

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Project

European X-Ray
Observatory
Satellite
(Exosat)

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RELEASE NO: 83-74

NASA TO LAUNCH EUROPEAN X-RAY OBSERVATORY SATELLITE

NASA will launch the European X-Ray Observatory Satellite (Exosat) for the European Space Agency (ESA) on a Delta 3914 launch vehicle from Space Launch Complex 2 West at Vandenberg Air Force Base, Calif., no earlier than May 26, 1983.

The 510 kilogram (1,125 pound) satellite will make a detailed study of the precise position and structure, spectral and temporal characteristics of known X-ray sources, and also search for new sources.

May 12, 1983

The earliest the launch of the Exosat satellite will occur is 8:18 a.m. PDT on May 26 at the opening of a 12-minute launch window. The three-stage Delta vehicle will place the Exosat into a highly elliptical orbit with a low point of 350 kilometers (217 miles) and a high point 200,000 km (124,274 mi.) above the earth's North Pole. It will take about four days to complete one orbit.

This unique orbit was picked because it provides maximum observation periods, up to 80 hours at a time, while keeping the spacecraft in full sunlight for most of the year, thereby keeping thermal conditions relatively stable and simplifying alignment procedures.

This new ESA project will provide X-ray astronomers with a powerful tool to further the development of this relatively new branch of high-energy astrophysics.

The telemetry data transmitted by Exosat will be received at the Villafranca ground station in Spain and routed in real time to the European Space Operations Center (ESOC) in Darmstadt, Federal Republic of Germany, where the control center and Exosat observatory ground systems are located. Extensive computer and display facilities will be available so that part of the data can be processed in real time and displayed immediately.

The Exosat satellite is 1.35 meters (4.4 feet) high, excluding its 1.85 m (6 ft.) solar array, and 2.1 m (6.9 ft.) in diameter. It weighs 510 kg (1,125 lb.), which includes 120 kg (265 lb.) of experiment instrumentation.

Exosat has a planned lifetime of two years, although the spacecraft has sufficient on-board resources to double this period if appropriate.

The industrial development of the spacecraft was entrusted to the European Cosmos Consortium, led by the German firm MBB, the system contractor. Responsibilities at system level cover management, engineering and assembly, integration and test. Subsystem responsibility has been shared by 20 European firms.

It was initially planned to launch Exosat on the European Ariane L6 launcher at the end of 1982. However, in February 1983, the ESA Council, in the aftermath of the L5 failure, decided that Exosat should be launched by an American Delta 3914 vehicle. Among the reasons for choosing the Delta vehicle were a desire to reassess the Ariane launch schedule, the risk of deterioration of certain Exosat payload elements if the spacecraft remained in storage too long, and the necessity to launch within the summer launch window in 1983. Under the terms of the launch services agreement with NASA, the European Space Agency will pay \$26 million for Exosat launch services.

The Delta Project Office at NASA's Goddard Space Flight Center, Greenbelt, Md., provides the Delta launch vehicle, and is responsible to the Office of Space Flight at NASA Headquarters for the technical management of the Delta Program. Kennedy Space Center, Fla., is responsible for launch at Vandenberg Air Force Base.

(END OF GENERAL RELEASE; BACKGROUND INFORMATION FOLLOWS.)

GENERAL DESCRIPTION

The Exosat satellite consists of a central body covered with super-insulating thermal blankets, and a one-degree of freedom rotatable solar array.

The scientific payload consists of four instruments:

- * A medium energy experiment comprising an array of gas-filled proportional counters generically similar to detectors flown through the 1970s but developed using the most up-to-date techniques and methods;
- * Two imaging telescopes, similar in function to the telescope flown on the Einstein Observatory and of comparable performance but with light-weight optics made using a new European-developed method of replication; and
- * A gas scintillator spectrometer which is a newly developed instrument that will be flown for the first time aboard Exosat.

The main objective of the Exosat mission is to make a detailed study of known X-ray sources, although it is also hoped to identify new sources.

The observatory will perform a number of duties. Primarily, it will pinpoint precise locations of X-ray sources. It will map diffuse extended sources such as supernova remnants and resolve sources within nearby galaxies and galaxies within clusters.

The spacecraft will perform broad band spectroscopy, or "color" cataloging of X-ray sources, and study the time variability of sources over timescales ranging from milliseconds to days, observing bursters, transients, pulsars, eclipsing binaries and active galaxies.

Finally, it will detect new sources in deep surveys or, by searching parts of the sky, to find counterparts to the high energy gamma sources discovered by an earlier ESA scientific satellite, COS-B, launched in 1975 and operated until April 1982.

PRINCIPAL SPACECRAFT SUBSYSTEMS

Attitude and Orbit Control

The satellite requires three-axis stabilization with stringent pointing and attitude reconstitution. Attitude control and re-orientation is provided by a propane cold-gas reaction control system, which incorporates two sets of six mutually redundant thrusters, with a variable thrust capability. Orbit control for occultation purposes is performed by a catalytically decomposed hydrazine motor. Attitude is determined by gyros, sun sensors and star trackers.

Electrical Power and Distribution

Primary electrical power is provided by the rotatable solar array. The 3,312 solar cells will provide some 260 watts of power to the onboard systems. The four-panel array is mounted on a rotary table so that its face can be kept pointed at the sun, whatever the viewing direction of the scientific instruments. To provide power in the launch phase and during eclipse, two rechargeable nickel cadmium batteries are employed.

Communications

Communication with the satellite is via two S-band transponders through antennae mounted on two booms deployed in orbit. Transponder power and satellite distance limits the down-link data rate to 8 kbps. An onboard computer is used to select, compress and format the scientific and spacecraft housekeeping data. The satellite can be controlled by ground command and the computer reprogrammed in orbit.

THE DELTA 3914 VEHICLE

The three-stage Delta 3914 configuration that will be used to launch Exosat is 35.36 m (116 ft.) tall and 2.4 m (8 ft.) in diameter without the attached solid rocket boosters. Liftoff weight will be approximately 190,631 kg (420,270 lb.). The average first stage thrust with six solids burning is 2,544,256 Newtons (572,000 lb.).

First Stage

The Delta first stage is the extended long-tank Thor, produced by McDonnell Douglas Astronautics Co., Huntington Beach, Calif. The first stage liquid-fueled rocket engine is thrust augmented by nine solid propellant strap-on motors. The rocket is 2.4 m (8 ft.) in diameter and 21.3 m (70 ft.) long. The first stage is powered by the Rockwell International, Rocketdyne Division's RS-27 engine derived from the Saturn 1B H-1 engine. The engine burns RP-1 kerosene as the fuel and liquid oxygen as the oxidizer.

The turbopump-fed engine develops 912,000 Newtons (205,360 lb.) thrust at liftoff, and burns to propellant depletion about 227 seconds after liftoff at an altitude of about 85 km (53 mi.).

Each of the nine TX-526-2 Castor IV strap-on solid propellant motors, produced by Thiokol Corp., Huntsville, Ala., develops 377,145 Newtons (84,790 lb.) thrust at ignition and burns for approximately 60 seconds. The Castor IV motors are each 11.3 m (37 ft.) high and 101.6 centimeters (40 in.) in diameter. Six of the solids will be ignited at liftoff. The other three are ignited 60 seconds later after the first six burn out. The simultaneous firing of explosive bolts holding ball and socket, and spring-actuated separation mechanisms located fore and aft on each motor separate the solids from the vehicle.

Second Stage

The second stage is also provided by McDonnell Douglas. The second stage measures 2.4 m (8 ft.) in diameter and is 7 m (23 ft.) tall. It utilizes liquid fueled TR-201 pressure fed engines provided by TRW, which can be restarted in space. The second stage engine burns hypergolic (ignite on contact) propellants using Aerozine-50 as the fuel and nitrogen tetroxide as the oxidizer. The second stage develops 45,590 Newtons (9,800 lb.) of thrust. Pitch and yaw steering during powered flight is provided by gimballing the engine. Roll steering during powered flight and all steering during coast are provided by a gaseous nitrogen cold gas system.

The guidance and control system of the vehicle is located on top of the second stage. The strap-down Delta Inertial Guidance System (DIGS) provides the guidance and control for the total vehicle from liftoff through attitude orientation. The system is composed of a digital computer provided by Delco and the Delta Redundant Inertial Measurement System (DRIMS) developed by McDonnell Douglas.

First and second stage telemetry systems are similar, both combining the use of pulse duration modulation and frequency modulation. Critical vehicle functions are monitored to provide data for determining which components, if any, are not functioning properly during ascent.

Third Stage

The Delta third stage includes the spin-stabilized TE-364-4 solid fuel motor built by Thiokol Corp. The third stage is 1.8 m (6 ft.) tall and 2.4 m (8 ft.) in diameter. It develops a thrust of 66,987 Newtons (15,060 lb.). A payload attach fitting is secured to the third-stage adapter and supports the satellite.

The satellite's protective nose fairing is 7.9 m (26 ft.) tall and 2.4 m (8 ft.) in diameter. The fairing is aluminum and constructed in two half-shells.

The fairing half-shells are jettisoned about 244 seconds into the flight by activation of the base separation nuts and the contamination-free mild detonating fuse in the thrusting joint cylinder cavity.

The following table shows the flight sequence of events.

FLIGHT SEQUENCE OF EVENTS

(Exosat Mission)

Event	Time (Sec)
Liftoff	0
Six Solid Motor Burnout	57.8
Three Solid Motor Ignition	60.0
Jettison Six Solid Motor Casings	78.0
Three Solid Motor Burnout	118.0
Jettison Three Solid Motor Casings	120.0
Main Engine Cutoff (MECO)	227.0
Stage I - II Separation	235.0
Jettison Fairing	244.0
Second Stage Engine Cutoff (SECO-1)	522.0
Start Coast Phase	522.0
Stage II Restart	2,315.0
Stage II Final Cutoff (SECO-2)	2,342.0
Spin Up	2,384.0
Stage II - III Separation	2,386.0
Stage III Ignition	2,428.0
Stage III Cutoff	2,472.0
Stage III - Exosat Separation	2,559.0

EXOSAT LAUNCH OPERATIONS

NASA launch operations from its West Coast installation are conducted by Kennedy Space Center's Expendable Vehicles Operations Directorate. Spacecraft cleanroom laboratory facilities, telemetry, data links, communications and logistics are provided by the Kennedy Resident Office and its contractor, Mercury Engineers.

These installations are located at the Western Space and Missile Center (WSMC), Vandenberg Air Force Base, near Lompoc, Calif., about 201 km (125 mi.) northwest of Los Angeles and 451 km (280 mi.) south of San Francisco. Launch facilities are located on a promontory jutting into the Pacific Ocean near Point Arguello, making it possible to place payloads in polar orbit without flying over populated areas.

Exosat will be launched aboard Delta 169 from Space Launch Complex 2 West at WSMC. Some Kennedy personnel are on permanent assignment as members of the Delta Western Operations Branch. These personnel are augmented by a larger management and technical group from the Kennedy Space Center in Florida, during final preparations and the launch countdown. A permanent work force is maintained at these facilities by McDonnell Douglas Corp., prime contractor on the Delta launch vehicle.

Preparations for the launch of the Exosat satellite began March 22 when the Delta first stage was erected on SLC-2 West. The interstage adapter was attached on March 25 and nine Castor IV solid rocket motors were installed during the week of April 5. The second stage was mated on March 28, and the third stage was to be mated on May 12.

The Exosat spacecraft arrived at the launch site on April 6. On May 5, it was taken to the Spin Test Facility for final assembly and testing. The spacecraft was scheduled for loading with propane and hydrazine attitude control propellants on May 9 and 10, and a final weighing of the spacecraft was to be conducted on May 11. The Exosat upper stage assembly is scheduled to be transported to the pad on May 16 and mated with the Delta vehicle. The payload fairing, which protects the satellite during its flight through the atmosphere, is scheduled to be installed on May 20.

ESA MANAGEMENT STRUCTURE

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(France)

Vice Chairman

Dr. H.H. Atkinson (U.K.)
Dr. H.H. Grage (Denmark)

Chairman of the Science Program
Committee

Professor C. de Jager
(Netherlands)

ESA Directorate

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Edmund Mallett

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Reinhold Steiner

Director of Space Transportation
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Roger-Maurice Bonnet

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Scientific Program Coordinator

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Head of Scientific Projects Dept.

Maurice Delahais

Exosat Project Manager

Gerhard Altmann

Head of Space Science Dept.

D. Edgar Page

Head of High Energy Astrophysics
Division

Brian Taylor

Exosat Project Scientist

Dieter Andresen

Head of Future Projects Office

Gordon Whitcomb

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NASA Headquarters

Lt. Gen. J.A. Abrahamson

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Robert E. Smylie

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Space Tracking & Data Systems**

Joseph B. Mahon

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Peter Eaton

**Chief, Expendable Launch
Vehicle Programs**

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Delta Program Manager

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Director

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Deputy Director

William C. Keathley

Director, Project Management

Robert C. Baumann

Acting Delta Project Manager

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Frank J. Lawrence

**Exosat Mission Integration
Manager**

Robert I. Seiders

Delta Network Support Manager

Karl Schauer

Exosat Network Support Manager

Ralph Banning

Network Director

Kennedy Space Center

Richard G. Smith

Director

Thomas S. Walton

Director, Cargo Operations

Charles D. Gay

**Director, Expendable Vehicles
Operations**

Wayne L. McCall

Chief, Delta Operations
Division

Ray Kimlinger

Chief, Western Operations
Branch

C.R. Fuentes

Spacecraft Coordinator

CONTRACTORS

McDonnell Douglas Astronautics Co.
Huntington Beach, Calif.

Delta Launch Vehicle

Rocketdyne Division
Rockwell International
Canoga Park, Calif.

First Stage Engine
(RS-27)

Thiokol Corp.
Huntsville, Ala.

Castor IV Strap-On
Fuel Motors

TRW
Redondo Beach, Calif.

TR-201 Second Stage
Engine

Delco
Santa Barbara, Calif.

Guidance Computer

Thiokol Corp.
Elkton, Md.

TE-364-4 Third Stage
Motor

-end-